Left Factoring | Left Factoring Examples

☛ Compiler Design

Grammar With Common Prefixes-

> If RHS of more than one production starts with the same symbol,
>
> then such a grammar is called as
>
> **Grammar With Common Prefixes**.

Example-

$$A \rightarrow \alpha\beta_1 \ / \ \alpha\beta_2 \ / \ \alpha\beta_3$$

(Grammar with common prefixes)

- This kind of grammar creates a problematic situation for Top down parsers.
- Top down parsers can not decide which production must be chosen to parse the string in hand.

To remove this confusion, we use left factoring.

Left Factoring-

> Left factoring is a process by which the grammar with common prefixes is transformed
>
> to make it useful for Top down parsers.

How?

In left factoring,

- We make one production for each common prefixes.
- The common prefix may be a terminal or a non-terminal or a combination of both.
- Rest of the derivation is added by new productions.

The grammar obtained after the process of left factoring is called as **Left Factored Grammar**.

Example-

A → aα1 / aα2 / aα3

Left Factoring →

A → aA'
A' → α1 / α2 / α3

Grammar
with
common prefixes

Left Factored Grammar
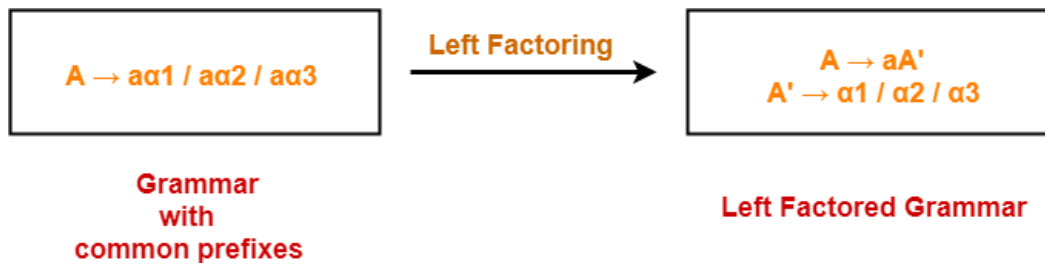
Also Read- Left Recursion

PRACTICE PROBLEMS BASED ON LEFT FACTORING-

Problem-01:

Do left factoring in the following grammar-

$$S \rightarrow iEtS \text{ / } iEtSeS \text{ / } a$$

$$E \rightarrow b$$

Solution-

The left factored grammar is-

$$S \rightarrow iEtSS' \text{ / } a$$

$$S' \rightarrow eS \text{ / } \in$$

$$E \rightarrow b$$

Problem-02:

Do left factoring in the following grammar-

A → aAB / aBc / aAc

Solution-

Step-01:

A → aA'

A' → AB / Bc / Ac

Again, this is a grammar with common prefixes.

Step-02:

A → aA'

A' → AD / Bc

D → B / c

This is a left factored grammar.

Problem-03:

Do left factoring in the following grammar-

S → bSSaaS / bSSaSb / bSb / a

Solution-

Step-01:

S → bSS' / a

S' → SaaS / SaSb / b

Again, this is a grammar with common prefixes.

Step-02:

S → bSS' / a

S' → SaA / b

A → aS / Sb

This is a left factored grammar.

Problem-04:

Do left factoring in the following grammar-

$$S \rightarrow aSSbS \ / \ aSaSb \ / \ abb \ / \ b$$

Solution-

Step-01:

$$S \rightarrow aS' \ / \ b$$

$$S' \rightarrow SSbS \ / \ SaSb \ / \ bb$$

Again, this is a grammar with common prefixes.

Step-02:

$$S \rightarrow aS' \ / \ b$$

$$S' \rightarrow SA \ / \ bb$$

$$A \rightarrow SbS \ / \ aSb$$

This is a left factored grammar.

Problem-05:

Do left factoring in the following grammar-

$$S \rightarrow a \ / \ ab \ / \ abc \ / \ abcd$$

Solution-

Step-01:

$$S \rightarrow aS'$$

$$S' \rightarrow b \ / \ bc \ / \ bcd \ / \in$$

Again, this is a grammar with common prefixes.

Step-02:

$$S \rightarrow aS'$$

$$S' \rightarrow bA \ / \in$$

$$A \rightarrow c \ / \ cd \ / \in$$

Again, this is a grammar with common prefixes.

Step-03:

$$S \rightarrow aS'$$

$$S' \rightarrow bA \ / \in$$

$$A \rightarrow cB \ / \in$$

$$B \rightarrow d \ / \in$$

This is a left factored grammar.

Problem-06:

Do left factoring in the following grammar-

$$S \rightarrow aAd \ / \ aB$$

$$A \rightarrow a \ / \ ab$$

$$B \rightarrow ccd \ / \ ddc$$

Solution-

The left factored grammar is-

$$S \rightarrow aS'$$

$$S' \rightarrow Ad \ / \ B$$

$$A \rightarrow aA'$$

$$A' \rightarrow b \ / \in$$

$$B \rightarrow ccd \ / \ ddc$$

To gain better understanding about Left Factoring,

Watch this Video Lecture

Next Article- Relationship With Left Recursion

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Summary